BIOLOGICAL EVALUATION OF SOUTHERN PINE BEETLE ON THE FRANCIS MARION NATIONAL FOREST

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ABSTRACT

An aerial survey (414.700 acres) and ground check on the Francis Marion National Forest indicate that southern pine beetle (SPB) (Dendroctonus frontalis Zimm.) activity is increasing. Seventy-one SPB spots were found within the Forest boundaries, and there are 69,772 acres of susceptible host type (1.02 spots per thousand acres of susceptible host type). Forest Pest Management (FPM) recommends that a suppression project be initiated on the Francis Marion National Forest.

INTRODUCTION

An aerial survey of the Francis Marion National Forest was conducted on August 31, 1982 by the FPM Aerial Survey Team (Wilson, 1982). A biological evaluation was then conducted to determine the present status and population trend of SPB on the Francis Marion. Entomologists from the FPM Asheville Field Office conducted the evaluation on September 7-9, 1982.

Historical Information

Over the past 20 years, the Francis Marion has experienced two SPB epidemics (Hoffard and Ghent, 1979). In 1966, the SPB population began increasing and continued to do so until it peaked in 1968. By 1969, the population had collapsed. In 1971, SPB again began to increase in numbers; however, it was four years before the epidemic peaked in 1975. This epidemic collapsed in 1976. In 1979, it appeared that SPB populations were increasing once more; however, populations never reached epidemic proportions, but rather, gradually declined with very little additional impact on the Forest (personal communication).

METHODS

Aerial Survey and Ground Check

Standard sketch mapping procedures were used in the aerial survey. Two observers each viewed a strip .5 mile wide. The flight lines were spaced 1 mile apart, resulting in a 100 percent survey. Spots of fading and/or red trees and the estimated number of trees per spot were recorded and plotted on Forest Service administrative maps.

Seven of the aerially detected spots were selected to be ground checked. Three spots which were not detected from the air were sampled, giving a total of 10 spots ground checked. The sample spots were selected to represent the spot size (number of trees) distribution from the aerial survey. The map in Figure 1 gives the locations of the spots which were sampled and the number of trees estimated in each spot from the air. At each spot ground checked, the causal agent was identified, and the number of infested and vacated trees by crown color (green, fading, red, or black), diameter and height of the first 20 trees, basal area, and average age were recorded. The ground check data are presented in Table 1. This information was used to run the economic analysis.

Suppression Project Criteria

The decision to initiate a SPB suppression project is based on the following criteria:

Number of SPB spots per 1,000 acres susceptible host type. One multiple tree SPB spot per thousand acres of host type has historically been considered the lower threshold of an epidemic. The continuous inventory of stand conditions (CISC) data for the Francis Marion National Forest was used to determine the acres of susceptible host type. The CISC data was accessed, and the number of acres of loblolly pine, shortleaf pine, pond pine, loblolly pine-hardwood, pond pine-hardwood, and pitch pine were determined. Only acreage in mature sawtimber, mature poletimber, and immature sawtimber within the above-mentioned host types was used in compiling the acreage of susceptible host type. Acreage under other stand condition classes, such as regeneration, sparse sawtimber, and seedling-sapling, were not used, because these stands would sustain neither large beetle populations at the onset of an epidemic nor large losses.

Green tree:red tree ratio. This ratio, which is based only on infested trees, indicates how rapidly an SPB population is expanding at the time of the ground check.

Volume of timber currently infested and economic evaluation. The volume of timber currently infested is calculated from the data collected at the ground checked spots. This volume is then used in the Southern Pine Beetle Economic Evaluation Program (SPBEEP) to develop the benefit cost ratio, internal rate of return, targets for timber to be removed, and the volume of timber protected by control efforts. As the current level of infestation increases, the economic benefits from a suppression project also increase.

Entomological judgement. Finally, observations made during the ground check and past experience are used to interpret the data and come to a final decision on a suppression project.

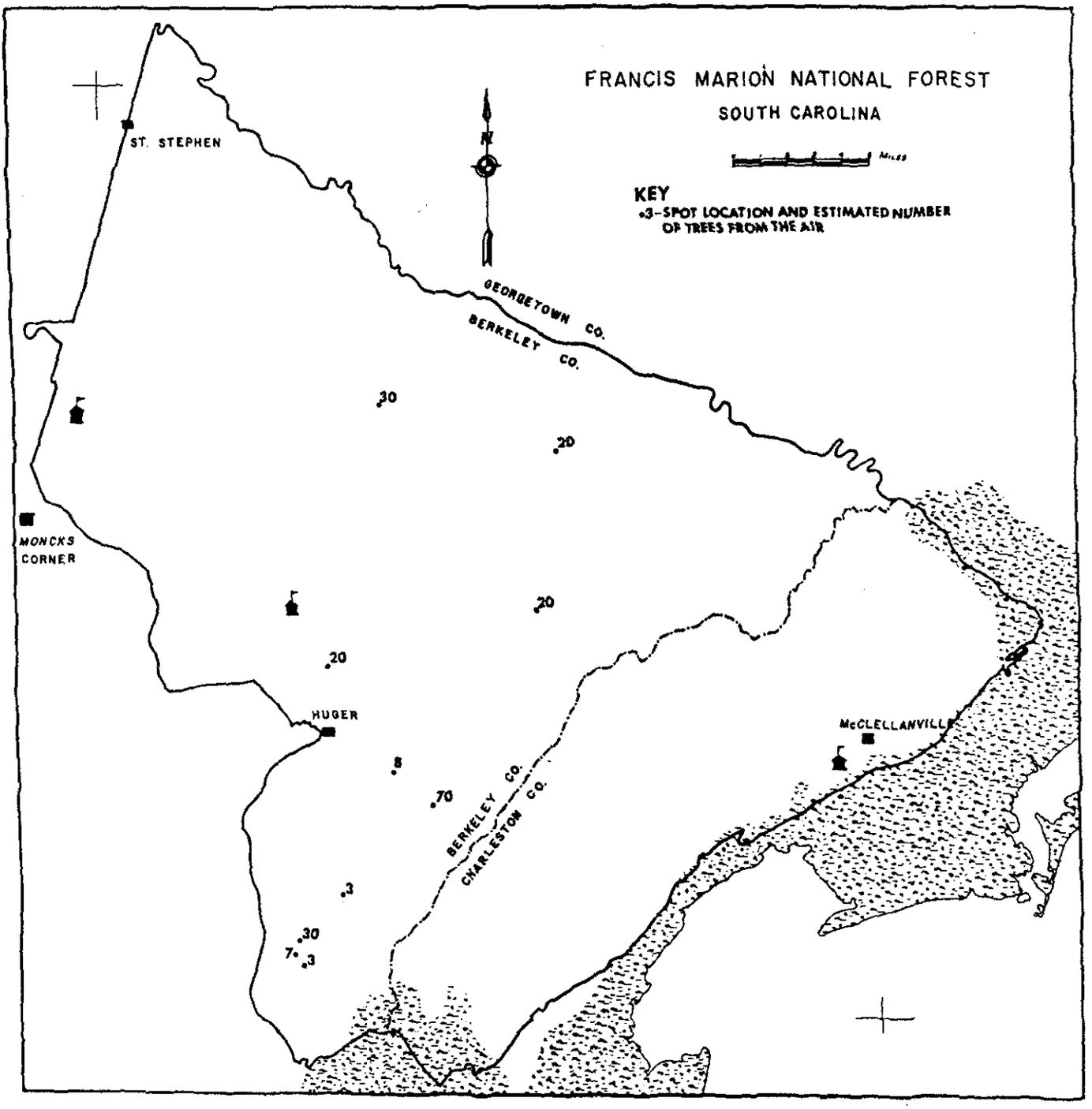

Figure 1.--The location of the spots sampled for the biological evaluation on the Francis Marion National Forest, 1982.

Table 1.--Summary of ground check data for the Francis Marion National Forest, September 1982.

Spot #	Aerial Size (trees)	No. Vacated Trees				No. Infested Trees			% Trees Infested	Green:Red Ratio	Basal Area	Age	$\bar{x}$ dbh/$\bar{x}$ ht	$\bar{x}$ vol (ft^3)
		Green	Red	Black	Total	Green	Red	Total						
1	70	37	89	70	196	9	0	9	4	9:0	150	30	9.6/46	10
2	-	0	4	2	6	0	1	1	14	0:1	210	30	12.4/76	24
3	-	0	0	0	0	3	0	3	100	3:0	150	45	17.0/80	51
4	30	2	0	31	33	4	0	4	11	4:0	220	75	25.7/94	124
5	-	0	0	0	0	3	0	3	100	3:0	150	20	8.7/45	8
6	20	0	13	12	25	24	2	26	51	12:1	190	40	14.9/76	38
7	20	1	9	20	30	70	8	78	72	8.75:1	150	45	14.5/70	33
8	7	0	8	2	10	2	5	7	41	0.4:1	90	53	9.0/42	7
9	20	0	2	10	12	12	0	12	50	12:0	140	65	17.6/111	74
10	30	2	25	11	38	27	6	33	47	4.5:1	110	50	15.1/92	45

RESULTS AND DISCUSSION

The aerial detection survey located 71 multiple tree spots within the Forest boundaries. Table 2 shows the distribution of spots by ownership and spot size category. Of the ten spots ground checked, all were actively infested with SPB. From this, it can be assumed that all spots on the Forest are active. The Francis Marion National Forest has 69,772 acres of susceptible host type, as determined through the use of CISC data. Therefore, there are 1.02 active SPB spots per 1,000 acres of susceptible host type on the Francis Marion National Forest.

The spots ground checked contained between 3 and 205 trees. In many cases, there were a large number of vacated black and red topped trees. The percent infested trees ranged from 4 to 100 and averaged 49 percent. The green infested:red infested tree ratios were high (eg., 12:1, 8.75:1), which indicates rapidly expanding populations. In half of the spots ground checked, there were green infested, but no red infested, trees. This indicates that either the spot is new or the spot had been inactive and recently became reinfested. This situation could also indicate that the population is increasing so rapidly that the normal progression of red vacant to red infested to green infested trees was not observed.

The estimated volume of trees currently infested is 226 MBF. At this time of year spot proliferation is occurring, so that in the spring we can expect an increase in the number of spots. Therefore, in the B/C analysis, we expanded the currently infested figures by 2.5 to account for spot proliferation. If a SPB suppression project was initiated, an estimated 476 MBF would be removed and 207 MBF protected. Detailed information on the economic benefits with and without a project can be found in Tables 3 and 4.

RECOMMENDATIONS

Forest Pest Management recommends that a SPB suppression project be initiated on the Francis Marion National Forest, based on the number of SPB spots per thousand acres of susceptible host type, the green:red infested tree ratio, and the economic analysis.

Salvage and cut-and-leave are the main suppression procedures we recommend using. A detailed discussion of suppression procedures, as well as preventive measures, follows.

CURRENT SUPPRESSION PROCEDURES

1. Removal of Infested Trees by Commercial Sale. When infested trees of merchantable size are accessible, they should be removed by commercial sale. Logging of the infested material should begin immediately. Contract time limits should insure rapid removal.

When practical, and if host type is present, a 40- to 70-foot buffer strip should be marked and cut adjacent to and ahead of the most recently infested trees. This practice is effective in reducing the possibility of "breakouts."

Table 2.--Summary of aerial survey data, Witherbee and Wambaw Ranger Districts, Francis Marion National Forest, August 31, 1982.

Ownership	Infestation Size (# trees) 3-5 Spots	6-10 Spots	11-25 Spots	26-50 Spots	51+ Spots	Total Spots
Witherbee District						
Federal	6	6	7	6	2	27
Private	2	1	5	4	0	12
Total	8	7	12	10	2	39
Wambaw District						
Federal	10	1	5	4	4	24
Private	1	1	1	4	1	8
Total	11	2	6	8	5	32

Table 3.--Southern pine beetle economic evaluation for the Francis Marion National Forest at 4% discount rate.

WITHOUT A PROJECT

Age	Harv. Obj.	Volume Lost (MBF)	Spot Growth Rate	Volume Threat (MBF)	Growth Rate (%)	Age at Harv.	Volume at Harvest (MBF)	Price at Harv.	Value at Harvest	Present Value
30	P/I 1/	13	.61	8	2.7	40	10	$ 17	$ 176	$ 114
30	S/F 2/	113	.61	69	1.7	60	117	165	19242	5705
40	P/I	13	.61	8	2.0	40	8	17	134	128
40	S/F	113	.61	69	1.2	60	89	165	14605	6409
50	S/F	84	.62	52	.8	60	57	165	9460	6145
60	S/F	84	.62	52	.6	60	53	165	8685	8351
Total		420		259			333		$52302	$26853
							Value of the volume not salvaged (lost)			$12600
								Total value lost		$39453

1/ pulp - intermediate cut

2/ sawtimber - final cut

Table 4.--Southern pine beetle economic evaluation for the Francis Marion National Forest at 6.875% discount rate.

WITHOUT A PROJECT

Age	Harv. Obj.	Volume Lost (MBF)	Spot Growth Rate	Volume Threat (MBF)	Growth Rate (%)	Age at Harv.	Volume at Harvest (MBF)	Price at Harv.	Value at Harvest	Present Value
30	P/I	13	.61	8	2.7	40	10	$ 17	$ 176	$ 85
30	S/F	113	.61	69	1.7	60	117	165	19242	2450
40	P/I	13	.61	8	2.0	40	8	17	134	125
40	S/F	113	.61	69	1.2	60	89	165	14605	3615
50	S/F	84	.62	52	.8	60	57	165	9460	4553
60	S/F	84	.62	52	.6	60	53	165	8685	8126
Total		420		259			333		$52302	$18953
								Value of the volume not salvaged (lost)		$12600
								Total value lost		$31553

Table 4.--con't

WITH A PROJECT

Age	Harv. Obj.	Volume Lost (MBF)	Spot Growth Rate	Volume Threat (MBF)	Growth Rate (%)	Age at Harv.	Volume at Harvest (MBF)	Price at Harv.	Value at Harvest	Present Value
30	P/I	3	.61	2	2.7	40	2	$ 17	$ 35	$ 17
30	S/F	23	.61	14	1.7	60	23	165	3848	490
40	P/I	3	.61	2	2.0	40	2	17	27	25
40	S/F	23	.61	14	1.2	60	18	165	2921	723
50	S/F	17	.62	10	.8	60	11	165	1892	911
60	S/F	17	.62	10	.6	60	11	165	1737	1625
Total		84		52			67		$10460	$ 3791

Value of the volume not salvaged (lost) $ 2520

Total value lost $ 6311

Project Benefits:	25243
Total Project Cost:	25000
Net Present Value:	243
Benefit Cost Ratio:	1.01
Internal Rate of Return:	7.03%
Composite Rate of Return:	6.91%
Targets	
Volume Removed:	476 MBF
Volume Protected:	207 MBF

When only a small volume of infested, merchantable material occurs in a spot, noninfested trees surrounding the spot may be marked to provide an operable cut.

The order of priority of removing beetle-infested timber from a spot should be as follows:

-- Trees in the buffer zone at the head(s) of the spot; if not removed within two weeks of marking, another visit and talley must be made in order to insure removal of all infested trees and an adequate buffer strip.

-- Trees with fresh attacks and having young broods (usually the green, recently infested trees).

-- Trees having nearly developed broods (usually the red and fading trees).

Remove infested trees from National Forest lands by commercial sale or administrative procedures in accordance with guidelines and procedures set forth in FSM 2400 through 2490.

2. Piling and Burning. Unmerchantable or inaccessible SPB infestations can be suppressed by cutting, piling, and thoroughly burning the bark of infested trees. The entire bark surface must be thoroughly burned to insure effective control. The order of priority for cutting, piling, and burning infested trees, particularly the large spots, is the same as paragraph (1) under "Removal of Infested Trees by Commercial Sale." Cutting a buffer strip is not recommended. To reduce the possibility of "breakouts," every effort should be made to locate and treat all green infested trees during the piling and burning operation.

3. Chemical Control. One chemical formulation recommended for SPB control is a one-half percent Lindane spray, with water as the carrier. This may be formulated from a 20 percent Lindane emulsifiable concentrate at the rate of 11 pints of concentrate in enough water to make 55 gallons of spray. (Ratio of one part 20 percent Lindane EC to 39 parts water.)

Dursban® (Chlorpyrifos) is also registered for SPB control. It is available as a liquid, containing 4 pounds of insecticide per gallon of concentrate. The spray is prepared by mixing 2-2/3 fluid ounces of concentrate with water to make 1 gallon or 2.1 gallons of concentrate in 100 gallons of water. Dursban®, a restricted-use pesticide, is to be applied only by or under the supervision of a certified pest control operator or other trained personnel responsible for insect control programs.

Cut, limb, and buck all infested trees into workable lengths. Spray the infested bark surface to the point of runoff. A compressed air sprayer (3-gallon capacity or equivalent) is an ideal applicator. Infested logs must be turned two or three times to insure complete treatment of infested bark. Spray stumps and bark removed by woodpeckers. Low pressure sprayers may be used to treat large, accessible infestations.

The order of priority for cutting and spraying infested trees in large spots is the same as paragraph (1) under "Removal of Infested Trees by Commercial Sale." Cutting a buffer strip is not recommended. To reduce the possibility of "breakouts," every effort should be made to locate and treat all green infested trees during the chemical control operation.

Never spray trees from which SPB brood has emerged. Natural enemies of the SPB in these trees can then complete their development.

Instructions for minimizing the adverse effects of mixing, transporting, and storing pesticides; applying pesticides; and disposing of pesticide containers and excess chemicals are outlined in Section 8.3 of the Forest Service Health and Safety Code FSM 5242.21.

4. Cut-and-leave. This control tactic reduces losses from spot growth and proliferation during the summer months. Cut-and-leave is designed to disrupt spot growth in small- to medium-sized spots (40 active trees) by dispersing emerging beetles. These spots can be salvaged when markets or weather permit. Trees are still suitable for sale months after felling.

The following procedure is to be followed when using cut-and-leave:

(1) Identify all active trees within the spot.

(2) Fell all active trees toward the center of the spot.

(3) Fell a horseshoe-shaped buffer of green uninfested trees around the most recently attacked trees at the head of the spot and leave them lying on the ground with crowns pointed toward the center of the spot. The buffer should be as wide as the average height of the trees in the stand.

Cut-and-leave treatments should only be applied during the summer months between June and October. Spots with 10 or more infested trees should be treated first. As time permits, spots with less than 10 infested trees should also be treated, if they contain trees with fresh attacks. In these smaller infestations where a specific head is not distinguishable, an adequate buffer strip (equivalent to the average height of the stand) and all infested and green uninfested trees within the spot should be felled.

Re-examination of Treated Areas. Re-examine areas where infested trees were removed by commercial sales, piled and burned, chemically treated, or cut and left within 2 or 3 weeks after treatment to check for additional infested trees. If additional trees are found, treat them.

In any area where infested trees are cut for chemical control or piling and burning, or removed through commercial sales and administrative use procedures, stumps adjacent to living pine trees should be treated to control or prevent the root rot Fomes annosus.

In stands that have been previously thinned or have had a history of F. annosus infection, the stumps should be treated with the competing fungus, Phlebia gigantea.

In stands that have no history of F. annosus and have never been thinned, the stumps should be treated with borax.

Southern pine beetle-infested tree stumps cut during the period of May through August, and below 34°N latitude, do not have to be treated with either of the above materials. This is because few spores are formed during this period and high temperatures often kill spores that are produced. However, routine summer thinning in areas of SPB buildup is not recommended.

PREVENTIVE MEASURES

The preceding represents only short term, immediate control strategies. Preventive measures form an important part of the integrated pest management process. Some of the more significant preventive measures include:

1. Preventing or minimizing littleleaf disease, a condition which predisposes these weakened trees to beetle attack. Depending on severity of infection, diseased trees may be removed during normal thinnings on a 6-year cutting cycle or as soon as merchantable. In high-hazard areas or when replanting known littleleaf sites, use loblolly pine or a more resistant tree species, as opposed to shortleaf pine.

2. Harvesting mature and overmature stands. Such stands are vulnerable to beetle attack and should be harvested as soon as possible.

3. Thinning stagnated stands. Overstocked stands are low in vigor and are more likely to be attacked. They should be thinned to a point that trees again show thrift and vigor.

4. Minimizing impact of natural disturbances which causes stand stress. These factors include ice, wind, hail, animal damage, flooding, erosion, poor soil fertility, etc. Corrective measures include removal of individually damaged trees, wholesale salvage, improving drainage, fertilization, etc.

5. Minimizing or eliminating man-caused disturbances. Logging, pipeline, sewerline, and powerline construction, or other construction activities require use of heavy equipment, which causes tree skinning and soil compaction and significantly weakens trees. Efforts to minimize the damaging consequences of these activities can significantly reduce the possibility of their leading to SPB problems.

PRECAUTIONARY PESTICIDE USE STATEMENT

Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels.

Store pesticides in original containers under lock and key--out of the reach of children and animals--away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment if specified on the container.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicides from equipment, do not use the same equipment for insecticides or fungicides that you used for herbicides.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary landfill dump, or crush and bury them in a level, isolated place.

NOTE: Some states have restrictions on the use of certain pesticides. Check your state and local regulations. Also, because registration of pesticides are under constant review by the U.S. Department of Agriculture, consult your county agricultural agent or state extension specialist to be sure the intended use is still registered.

REFERENCES

Hoffard, W. H. and J. H. Ghent. 1979. Biological evaluation of southern pine beetle infestations on the Francis Marion-Sumter National Forests, S.C. USDA Forest Service, S&PF, FPM, Asheville, N.C. Rep. No. 79-1-42.

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